

Use of Lined Pits for
Disposal of Dilute Pesticide Waste

Engineering and Economics Research, Inc.
Vienna, VA

Prepared for

Environmental Protection Agency, Cincinnati, OH

Jan 87



U.S. Department of Commerce
National Technical Information Service

NTIS

EPA/600/2-87/003
January 1987

USE OF LINED PITS FOR DISPOSAL OF DILUTE PESTICIDE WASTE

by

George R. Bierman
Narinder P.S. Malik
Engineering and Economics Research, Inc.
1951 Kidwell Drive
Vienna, Virginia 22180

Contract No. 68-02-3982

Project Officer

Brian A. Westfall
Alternative Technologies Division
Hazardous Waste Engineering Research Laboratory
Cincinnati, Ohio 45268

HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U. S. ENVIRONMENTAL PROTECTION AGENCY
CINCINNATI, OHIO 45268

TECHNICAL REPORT DATA (Please read instructions on the reverse before completing)		
1. REPORT NO. EPA/600/2-87/003	2.	3. RECIPIENT'S ACCESSION NO. PB87 145926/AS
4. TITLE AND SUBTITLE USE OF LINED PITS FOR DISPOSAL OF DILUTE PESTICIDE WASTE	5. REPORT DATE January 1987	
	6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S) George R. Bierman Narinder P. S. Malik	8. PERFORMING ORGANIZATION REPORT NO.	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Engineering and Economics Research, Inc. 1951 Kidwell Drive Vienna, Virginia 22180	10. PROGRAM ELEMENT NO.	
	11. CONTRACT/GRANT NO. 68-02-3982	
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency Hazardous Waste Engineering Research Laboratory 26 W. St. Clair St. Cincinnati, OH 45268	13. TYPE OF REPORT AND PERIOD COVERED	
	14. SPONSORING AGENCY CODE EPA/600-12	
15. SUPPLEMENTARY NOTES		
16. ABSTRACT Modern agricultural practices rely heavily on the use of pesticides to sustain high productivity. When pesticide containers and application equipment are rinsed after use, the contaminated water requires proper disposal. At Iowa State University in Ames, Iowa, dilute pesticide rinsates have been placed in a concrete-lined pit for more than ten years. The pit contains alternating layers of gravel and soil. Water evaporates from the pit surface while pesticide chemicals are adsorbed on soil particles destroyed by microorganisms or broken down chemically. Similar lined pits have been used at several locations around the nation. This investigation includes a review of design criteria for lined disposal pits as well as descriptions of some of the pits now in use.		
17. KEY WORDS AND DOCUMENT ANALYSIS		
a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
18. DISTRIBUTION STATEMENT RELEASE TO PUBLIC	19. SECURITY CLASS (This Report) UNCLASSIFIED	21. NO. OF PAGES 41
	20. SECURITY CLASS (This page) UNCLASSIFIED	22. PRICE

NOTICE

This document has been reviewed in accordance with U. S. Environmental Protection Agency policy and approved for publication. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of solid and hazardous wastes. These materials, if improperly dealt with, can threaten both public health and the environment. Abandoned waste sites and accidental releases of toxic and hazardous substances to the environment also have important environmental and public health implications. The Hazardous Waste Engineering Research Laboratory assists in providing an authoritative and defensible engineering basis for assessing and solving these problems. Its products support the policies, programs and regulations of the Environmental Protection Agency, the permitting and other responsibilities of state and local governments and the needs of both large and small businesses in handling their wastes responsibly and economically.

This report describes the use of concrete-lined pits for the disposal of dilute aqueous pesticide waste. When pesticide containers and application equipment are cleaned by rinsing, the resulting contaminated water requires proper disposal. The dilute waste may be fed into a lined pit partially filled with soil and gravel. Water evaporates from the pit surface while pesticide chemicals are biologically or chemically degraded. The report will be useful to pesticide applicators generating 10,000 gallons or less of dilute pesticide wastes each year.

Thomas R. Hauser, Director
Hazardous Waste Engineering Research Laboratory

ABSTRACT

Modern agricultural practices rely heavily on the use of pesticides to sustain high productivity. When pesticide containers and application equipment are rinsed after use, the contaminated water requires proper disposal. At Iowa State University at Ames, dilute pesticide rinsates have been placed in a concrete-lined pit for more than ten years. The pit contains alternating layers of gravel and soil. Water evaporates from the pit surface while pesticide chemicals are absorbed on soil particles, destroyed by microorganisms or broken down chemically. Similar lined pits have been used at several locations around the nation. This investigation includes a review of design criteria for lined disposal pits as well as descriptions of some of the pits now in use.

This report was submitted in partial fulfillment of Contract No. 68-02-3982 by Engineering and Economics Research, Inc., Vienna, Virginia, under the sponsorship of the U.S. Environmental Protection Agency. This report covers a period from September 1984 to May 1985, and work was completed as of May 31, 1985.

CONTENTS

Foreword.....	iii
Abstract.....	iv
Figures.....	vi
Acknowledgements.....	vii
1. Introduction.....	1
2. Pit Design.....	2
3. Siting, Operation and Maintenance.....	20
Appendices	
A. State Agencies Dealing with Hazardous Wastes.....	23
B. U.S. EPA Regional Offices - Resource Conservation and Recovery Act (RCRA) Contacts.....	30
C. Source of Climatic Information.....	32

FIGURES

<u>Number</u>		<u>Page</u>
1	The Iowa State University Pesticide Waste Disposal Pit.....	3
2	The University of Florida, Ft. Lauderdale Agricultural Research Station Pesticide Waste Disposal Pit.....	5
3	The University of Florida, Sanford Agricultural Research Station or Agway Corporation Pesticide Waste Disposal Pit.....	7
4	Annual Shallow Lake Evaporation Rates in Inches.....	9
5	May to October Shallow Lake Evaporation Rates in Inches.....	10
6	May to October Pan Evaporation Rates in Inches.....	11
7	Conversion Coefficients for Pan Evaporation Rates Expressed as Percentages.....	12
8	Selected Concrete Details.....	14
9	Design Details When Concrete Block Walls are Used.....	15
10	Pit Liners and Leak Detection.....	17
11	Pit Roof Arrangement.....	19

ACKNOWLEDGEMENTS

The authors wish to express their appreciation to a number of individuals who provided valuable guidance and advice in the preparation of this report. These individuals include: Dr. Charles Hall of Iowa State University; Mr. Paul Clayton of the Land-O-Lakes Company; Mr. John Nicholson of the U. S. Department of Agriculture Soil Conservation Service; Mr. Norwood Talbert and Mr. Ed Brown of Agway, Inc.; Dr. Donald Reddell of Texas A & M University; Dr. Keith Furr of Virginia Polytechnic and State University; Mr. Roland Wolf of the ICI Americas, Inc. Research Farm; Mr. Bruce Davidson of FMC Corporation Research Farm; Dr. Fred Slife of the University of Illinois; Dr. William Ennis of the University of Florida at Ft. Lauderdale; and Drs. John Darby and Walter Scudder of the University of Florida Agricultural Research Station, Sanford.

Gratitude is also expressed for the following individuals who have given advice in the preparation of this document; Mr. Charles Rogers of the Hazardous Waste Engineering Research Laboratory, U. S. Environmental Protection Agency; Dr. Raymond Krueger and Mr. Alfred Lindsey, Headquarters Staff, U. S. Environmental Protection Agency; Mr. Karl Klepitsch and Ms. Edith Ardiente of Region V, U. S. Environmental Protection Agency; and Mr. Marcus Rivas and Mr. Chet McLaughlin of Region VII, U. S. Environmental Protection Agency.

Last, but not least, the authors are greatly indebted for the kind cooperation of Ms. Cynthia Green, Ms. Linda Prieto and Ms. Linda Simmons for their assistance and patience in the production of this report.

SECTION 1

INTRODUCTION

The pesticide disposal facility on which this report is based was developed in the 1960's at the Horticulture Department of Iowa State University in Ames, Iowa. The system, called simply a "pesticide disposal pit" by its developers, was created to provide a safe alternative to the practice of disposing of waste pesticide solutions by indiscriminately dumping them on unused fields or field fringes. The pits were intended to be particularly useful to farmers who generate relatively small quantities of waste pesticide solutions at any given time and for those who use a variety of pesticides on different crops. A demonstration facility was built at Iowa State University in 1970 and has been in continuous use since then. No major operating nor pollution problems have occurred at the demonstration pit. A detailed technical report on the Iowa State Facility entitled Safe Disposal Methods for Agricultural Pesticide Wastes (No. PB 81-197584) is available through the National Technical Information Service.

The pesticide disposal pit represented here is intended for use by individual farmers and others who generate 10,000 gallons or less dilute pesticide waste annually. Any pit will be subject to all applicable federal, state and local environmental laws and regulations. If the user intends to dispose of pesticide wastes which have been designated as hazardous materials under the Resource Conservation and Recovery Act, a permit to build and operate the pit may be required. To assist in determining whether or not a permit is needed, the state agencies responsible for hazardous waste management are listed in Appendix A. Corresponding federal organizations in regional offices are listed in Appendix B.

SECTION 2

PIT DESIGN

In the late 1960s, the Department of Horticulture at Iowa State University developed a concept for disposing of waste pesticide solutions. A facility based on the concept was built in 1970 at the University's Horticulture Research Station and has been in continuous use since that time with satisfactory results. It is essentially the Iowa State design for the waste pesticide pit that is described here, with some modifications from the original. In addition, a few variations on the design that have been developed and used by others are included.

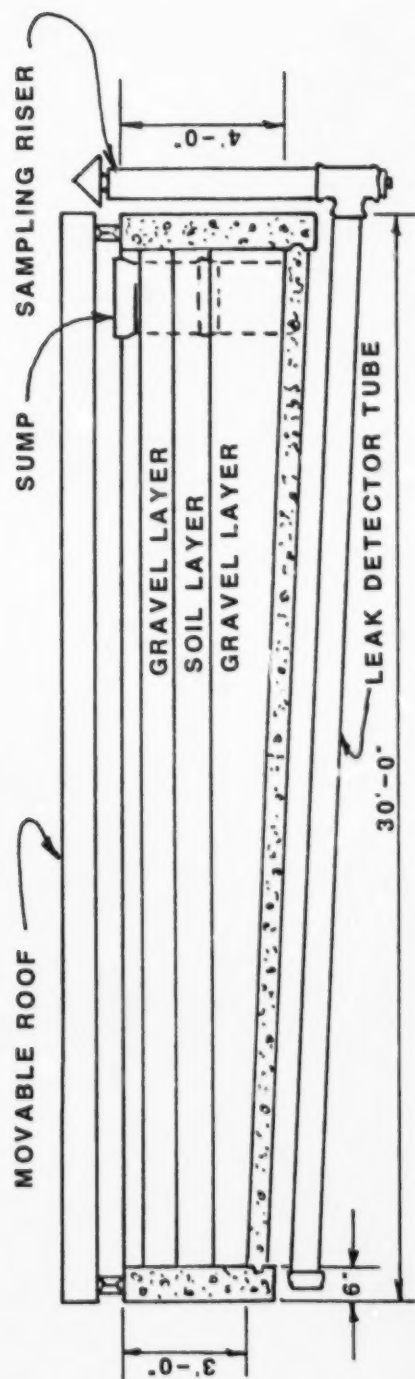
The Iowa State University (ISU) Design

In brief, the ISU design is a rectangular, open-top tank constructed of concrete and partially filled with alternating layers of heavy gravel and soil. See Figure 1. The pit is about three feet deep and is set into the ground so that only about the upper six inches of the walls rise above the surface of the ground. In operation, waste pesticide solutions are loaded into the pit to a depth of not more than two inches over the top gravel layer. The water evaporates and the pesticide chemicals are destroyed by bacteria and by photolytic action (depending on exposure of the liquid to sunlight).

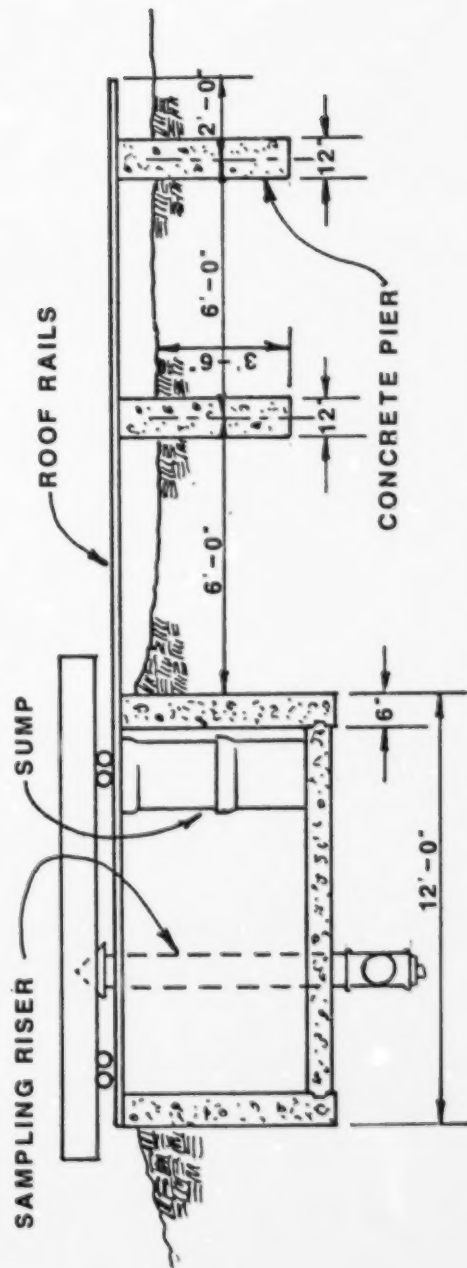
There are several key features of the ISU design to be noted in Figure 1. One is the installation of a sump in one corner of the pit. This allows for collection of liquid samples. It also provides ready access for pump-out of the pit should it become necessary; for example, if a leak through the concrete is detected.

The leak detection system is the second key feature, and is provided by perforated pipe or tile installed beneath the pit and running to a sampling riser located just outside one end of the pit. The notion is that, should the concrete walls or bottom develop a leak, the fluid will soon find its way to the perforated pipe and to the bottom of the riser, where it can be seen. The riser itself would be capped to prevent entry of rain or snow. Thus, so long as there are no leaks from the pit, the riser bottom will remain dry.

Although Figure 1 shows that the pit bottom is sloped toward one end and the ISU pit is, indeed, so constructed, it is not believed that the sloped bottom is necessary. That is, a flat bottom will suffice. Another



LONGITUDINAL CROSS SECTION



TRANSVERSE CROSS SECTION

Figure 1. The Iowa State University Pesticide Waste Disposal Pit

key feature of ISU's original design is the method provided for loading the pit i.e., feeding waste pesticide solutions into the pit. This was through a perforated horizontal pipe placed just below the top of the soil (i.e., the middle) layer. It was intended that the waste solutions would be fed (by gravity) through this pipe from one or more risers extending up and out of the pit, where hose or other pipe connections could readily be made between the loading pipe and pesticide application equipment being emptied and cleaned. However, because of the time required to load larger quantities of waste solutions into the pit through this pipe, its use has been discontinued in favor of spreading the solutions directly onto the surface of the top layer of gravel.

The final key feature of the ISU design is the pit roof. In this case, the roof is mounted on wheels which run on rails along the tops of the end walls. Normally, the roof is kept off the pit, allowing full pit surface exposure to the sun and wind. The roof is motor-operated, and is activated by a precipitation sensor, so that it will roll into position covering the pit in the event of rain. Based on ISU experience, the movable roof is no longer considered to be desirable. A fixed roof, covered with translucent fiberglass, and raised perhaps two feet above the top of the pit, is preferred.

Variations On The ISU Design

Numerous interested parties have observed the ISU pit and have reviewed the design. A few have built essentially identical pits. Others have built similar pits but have introduced their own design concepts, some of which can prove to be practical and useful.

At the University of Florida's Ft. Lauderdale Agricultural Research Station, for example, variations have been introduced in both construction, fill material, and loading arrangement. See Figure 2.

Here, the pit bottom is of concrete, poured with a six-inch curb. The walls are of concrete block, built up to a height of 36 inches above the top of the curb. The concrete block walls require special attention for positive sealing against leaks. This is accomplished by the application of hydraulic sealing materials and by an interior liner. The liner consists of two layers of 8-mil black polyethylene. The pit is filled to a depth of 24 inches with alternating layers of gravel and soil.

Leak detection is provided by a grid arrangement of perforated PVC pipes beneath the pit and connected to vertical sampling risers outside the pit along the sides and ends. The risers are capped, and their bottoms should be dry so long as there are no leaks. To enhance leak detection, a black polyethylene liner placed in the earth beneath the leak detection pipes prevents any leaking solution from leaching down into the soil or the groundwater. (The water table is very high in the area.) By holding any leaked solution near the pit bottom, the liner increases the chances that the solution will appear in the bottom of the sampling risers. The liner is also positioned to aid in directing any leaked solution toward a

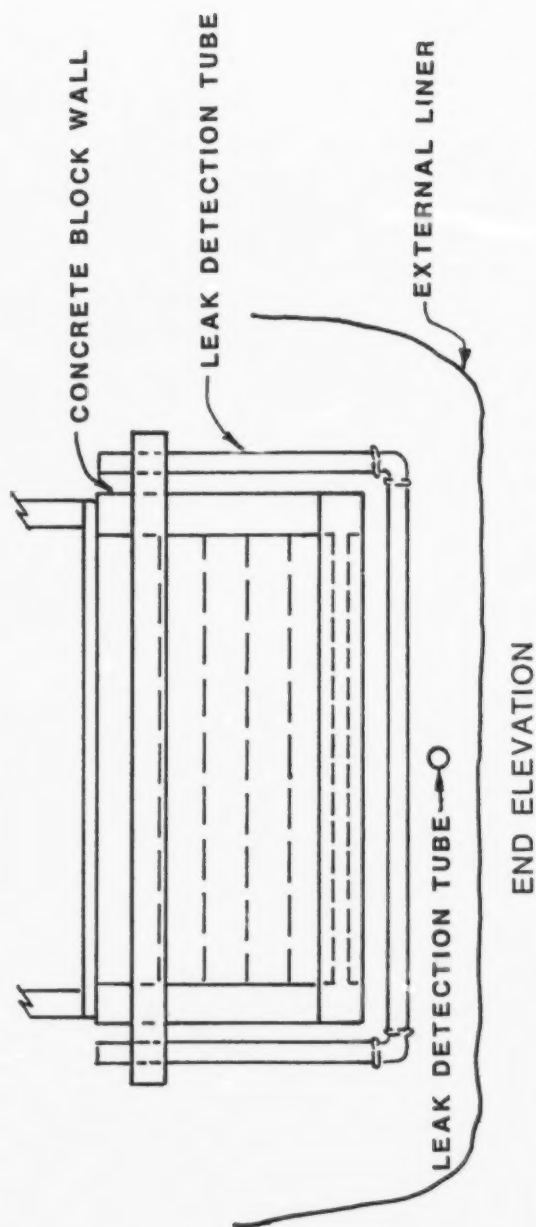
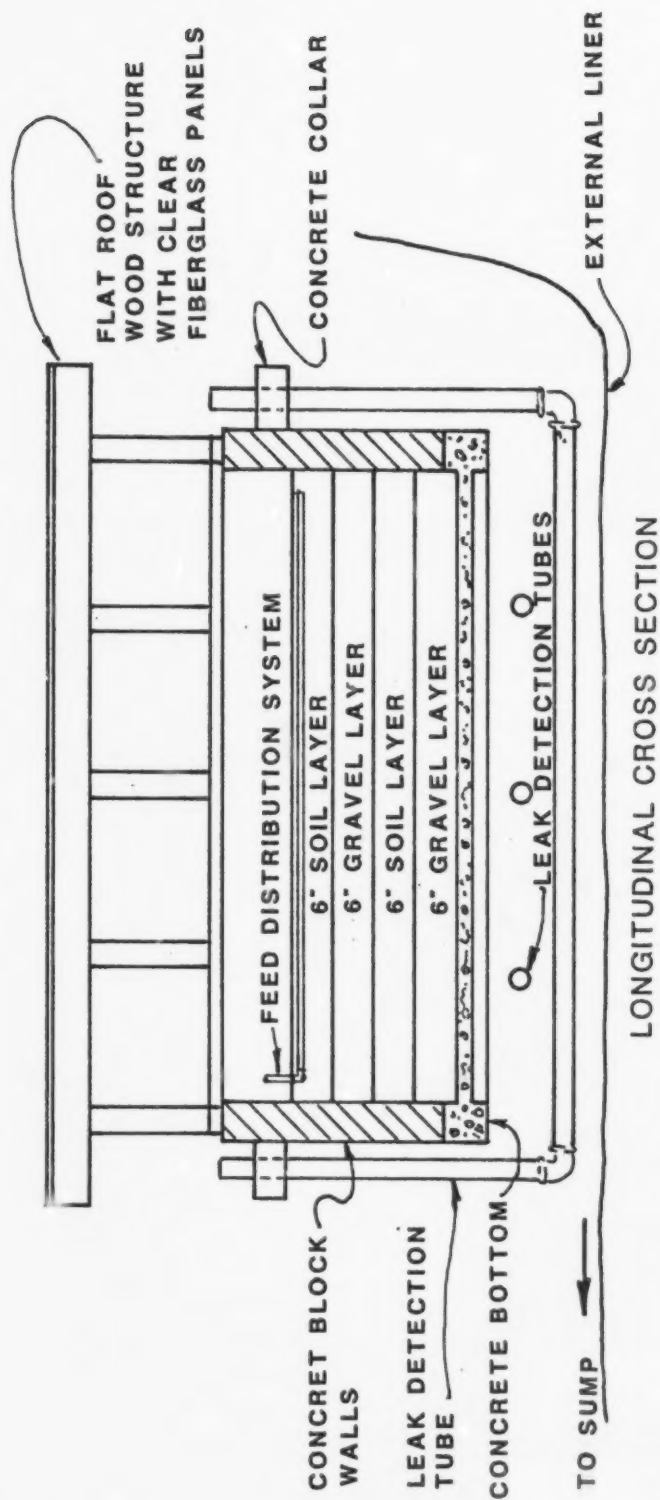


Figure 2. University of Florida, Ft. Lauderdale Agricultural Research Station Pesticide Disposal Pit

sump located off one end of the pit, where the presence of liquid would not only indicate a leak, but aid in controlling it as well by collecting the leakage.

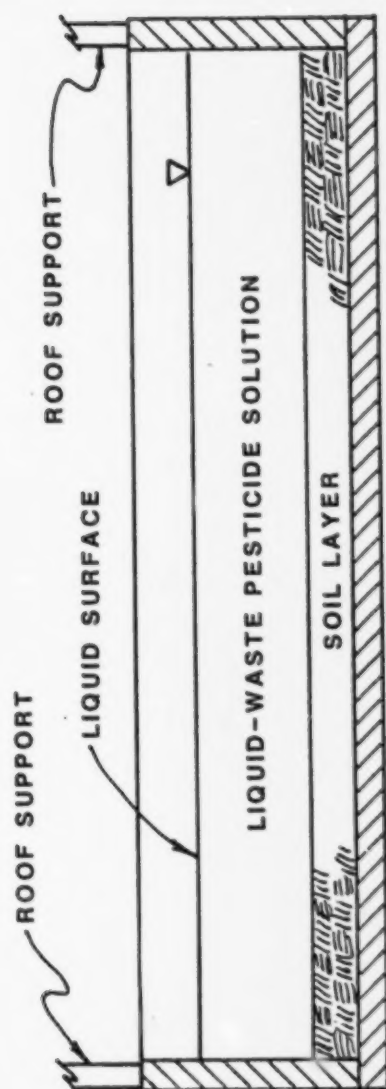
Loading of waste pesticide solutions into the pit is by a pipe from the sinks in the adjacent pesticide mixing room. The pipe enters the pit near a corner, then connects to a perforated pipe that runs the length of the pit at the center, and is buried just beneath the surface of the top layer (soil) of pit fill. The soil is local topsoil which is sandy, a factor that promotes rapidity in transfer of waste pesticide solutions from the loading pipe into the pit. While the water evaporates, pesticide degradation is by aerobic and anaerobic microbial action, depending on depth in the pit. Degradation by photolysis will also occur, should the pit be filled to a level above the top surface of the fill material.

A pit design variation that is a major departure from the ISU concept, but is also useful is one in which a layer of soil is initially placed in the pit, then waste pesticide solutions are fed into the pit until a liquid depth of 18-24 inches above the top of the soil layer is introduced. See Figure 3. In this concept, characterized by pits used at the University of Florida's Sanford Research Station and at the Agway Corporation's Farm Research Center at Tully, New York, pesticide solids settling out of the solution will be anaerobically degraded by microbial activity in the soil layer, while the water evaporates. Some photolytic degradation will also take place, depending on exposure of the liquid to sunlight. Evaporation rates are likely to be slower than in the ISU concept, because of the greater liquid depth and its resultant ability to absorb heat without increasing the vaporization rate.

Other design features of these pits would be similar to those of the ISU-style pits, but a principal difference is found in the loading arrangements. In the Sanford Research Station's pit, the waste pesticide solutions simply run into the pit through a pipe that protrudes through one end-wall at a height just above the highest anticipated liquid level. At Agway, a U-shaped, perforated PVC pipe (with the "U" nearly the length and width of the pit) is suspended some 15-18 inches above the liquid surface. The waste solutions are pumped into this suspended pipe and allowed to drain into the pit, with good distribution provided by the length and width of the U-shaped pipe run.

Determining Evaporation Rates

While the active chemicals in the waste pesticide solutions are degraded in these pits by microbial action and by photolysis, the key to their continued successful operation is the rate at which the liquid evaporates. The rate of evaporation determines what quantity of solution can be loaded into the pit over the course of a year in general and a growing season in particular.



LONGITUDINAL CROSS SECTION

Figure 3. University of Florida, Sanford Agricultural Research Station and Agway Corporation Pesticide Disposal Pit

Therefore, knowledge of local evaporation characteristics is critical in determining the size of the pit, in terms of surface areas. The needed evaporation data can be obtained from a variety of sources, chief among which are weather stations (typically located at airports) and publications of the U.S. Weather Service (see Appendix C).

Shallow lake evaporation rates for a portion of the midwestern United States are shown in Figure 4. The numbered lines indicate the average number of inches of water that can be expected to evaporate at that location over a period of a year. For locations situated between lines, an estimate of the evaporation rate can be made by noting the relative distance from the location to the nearest upper and lower lines of evaporation rate. For example, the city of Des Moines, Iowa is in an area where the next higher evaporation rate is 40 inches per year and the next lower rate is 38 inches per year. Thus, a reasonable estimate of evaporation rate at Des Moines is 39 inches of water per year. Note that both of the lines closest to Des Moines represent an evaporation rate of 40 inches per year. This means Des Moines is located between two places where 40 inches of water evaporate in a year. However, to determine the evaporation rate for Des Moines, or for any location not right on a numbered line, the nearest higher and nearest lower evaporation rates must be determined, even though the higher and lower lines may not be the closest lines.

For central and northern states, the evaporation rate during the growing season of May-October will be more representative of expected pit evaporation. These rates are shown in Figure 5. The May-October evaporation rate for Des Moines is between 28 inches and 30 inches. An estimate of 29 inches can be used.

If lake evaporation rates are not available, they can be determined from pan evaporation rates and pan coefficients. Figure 6 shows pan evaporation occurring between May-October, while Figure 7 reflects the conversion factor in percent to develop lake evaporation rates. For Des Moines the May-October evaporation rate is about 39 inches (between 38 inches and 40 inches on Figure 6) while the pan coefficient from Figure 7 is 76%. The estimated May-October lake evaporation rate is therefore $39 \times 0.76 = 29.6$ inches. This estimate is very close to the 29 inches determined from the May-October lake evaporation rate map, Figure 5.

The evaporation data outlined above are average values over a period of several years. Conservative estimates should therefore be used in designing pesticide pits so they can still be used during periods of below-average evaporation.

Determining Pit Size

Given that evaporation is critical to the satisfactory operation of the pesticide disposal pit, a method is needed to relate pit size to the evaporation rate of interest in any given location.

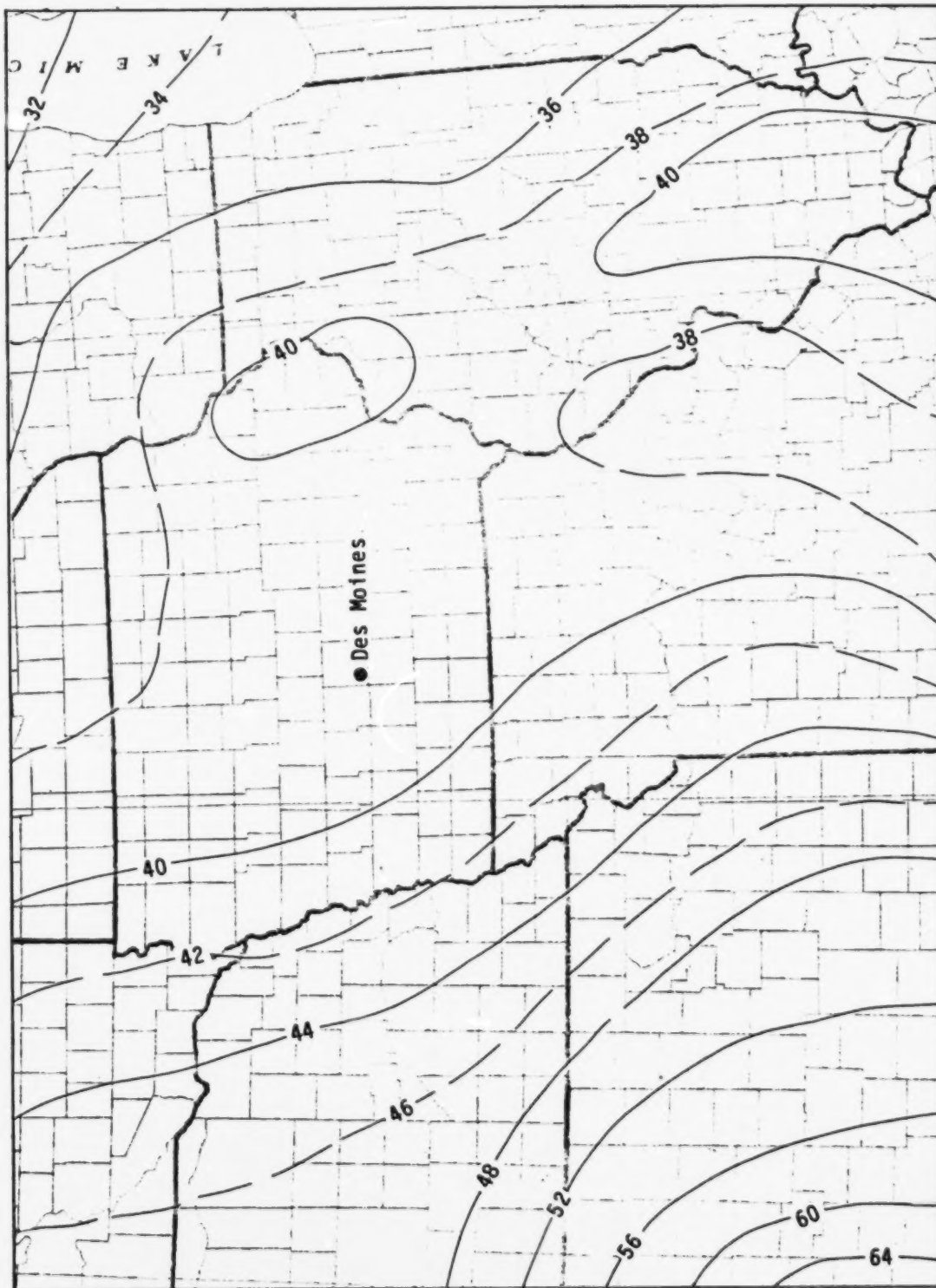


Figure 4. Annual shallow lake evaporation rates in inches

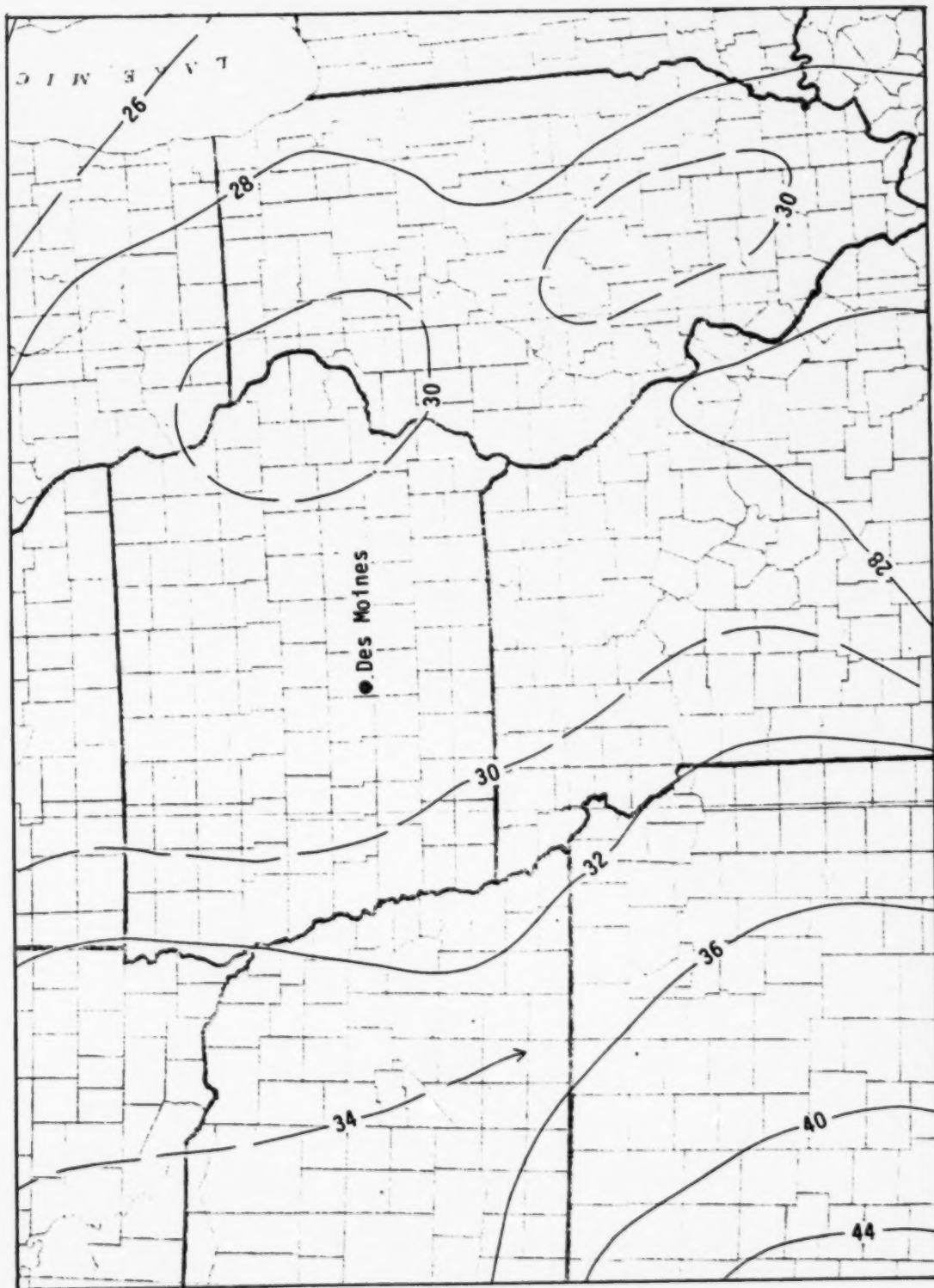


Figure 5. May to October shallow lake evaporation rates in inches

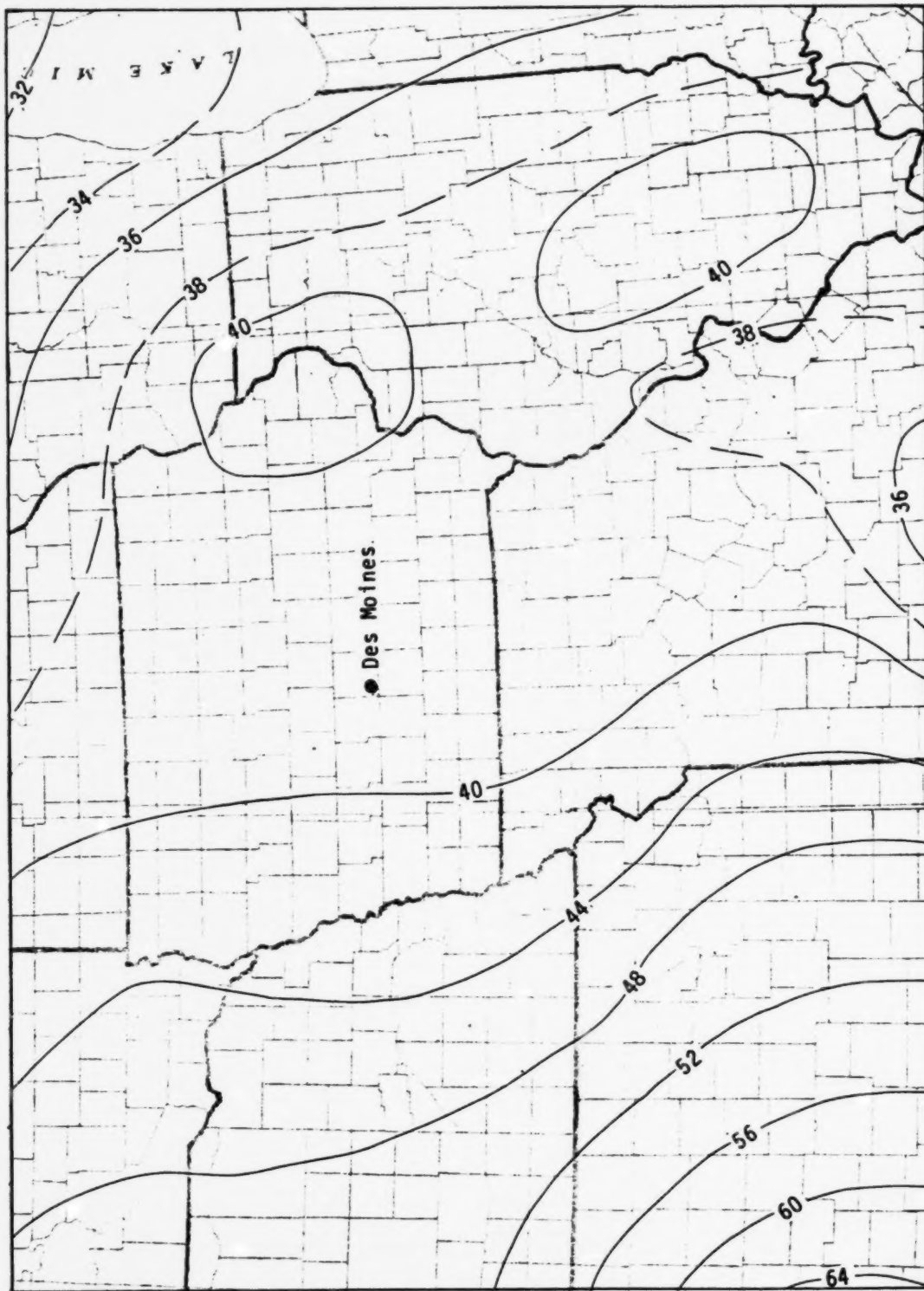


Figure 6. May to October pan evaporation rates in inches

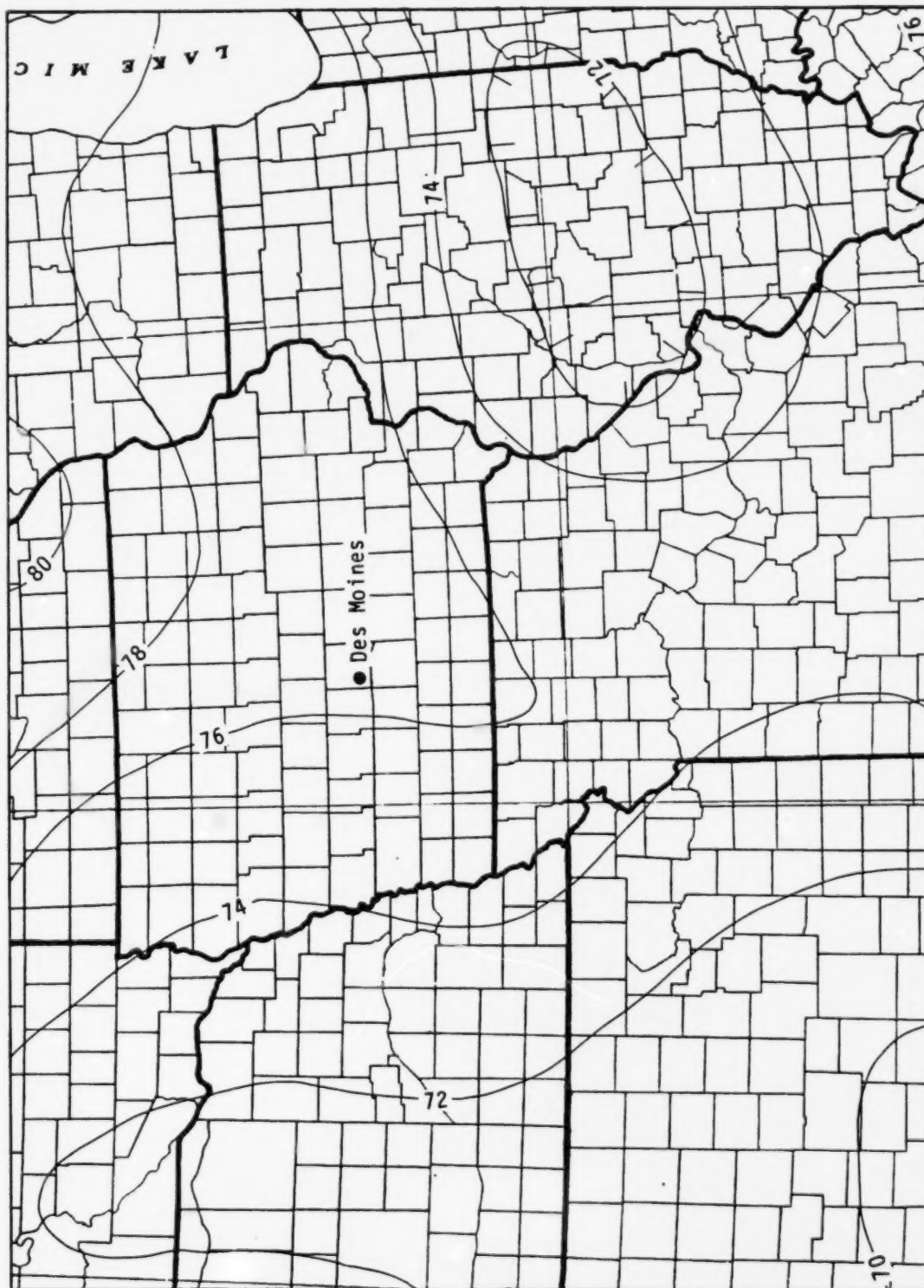


Figure 7. Conversion coefficients for pan evaporation rates expressed as percentages

Water one-inch deep and having a surface area of one square foot represents a volume of 0.62 gallons, and this value can be used together with evaporation data to determine appropriate pit size, in terms of surface area needed to evaporate the waste pesticide solutions loaded into the pit over the time period of concern. For example, using the Des Moines May-October evaporation value of 29 inches estimated above, it can be computed that from each square foot of surface area, about 18 gallons ($29 \times 0.62 = 17.98$) of water will evaporate during the May-October period. The amount of water used to wash containers and pesticide application equipment over the growing season must be estimated. The required pit size is calculated by the following equation:

$$\frac{\text{gallons of rinsate per year}}{\text{gallons evaporated per square foot of area}}$$

For our example in Des Moines, if 2500 gallons of rinsate is generated in a year, the pit size will be $\frac{2500}{18} = 138.9$ or about 140 square feet. A

pit 10 feet wide and 14 feet long would be sufficient.

Pit Walls and Bottom

The most desired characteristic of the walls and bottom of the pit is that they be watertight. Therefore, it is preferred that they be constructed of reinforced concrete having a 28-day comprehensive strength of at least 3,500 pounds per square inch. The concrete should conform to all applicable state and local standards.

Since the bottom and the walls will be poured separately, special attention must be given to the joint between them to achieve the necessary watertightness. Figure 8 illustrates one construction technique for a leak-proof joint.

As an alternative, the pit walls can be constructed of concrete block. This will present special sealing problems because of the many joints in the block walls, in addition to the joint between the walls and the pit bottom. When the walls are completed, their exterior surfaces should be rather heavily coated with cementitious sealant, then parged. Their interior surfaces should also be heavily coated with cementitious sealer, with special attention given to the joint between the pit walls and bottom. Figure 9 provides design details for the use of concrete block walls.

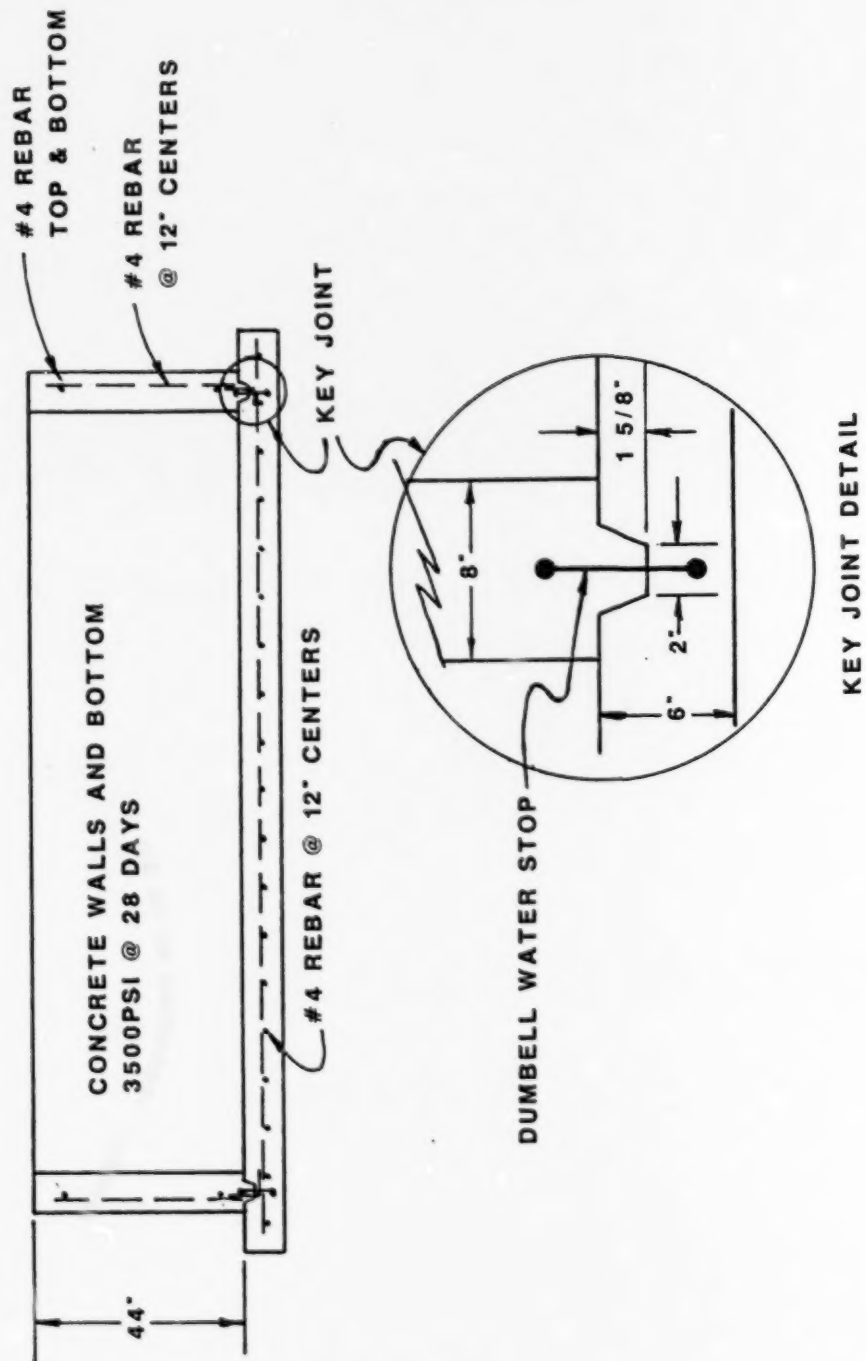
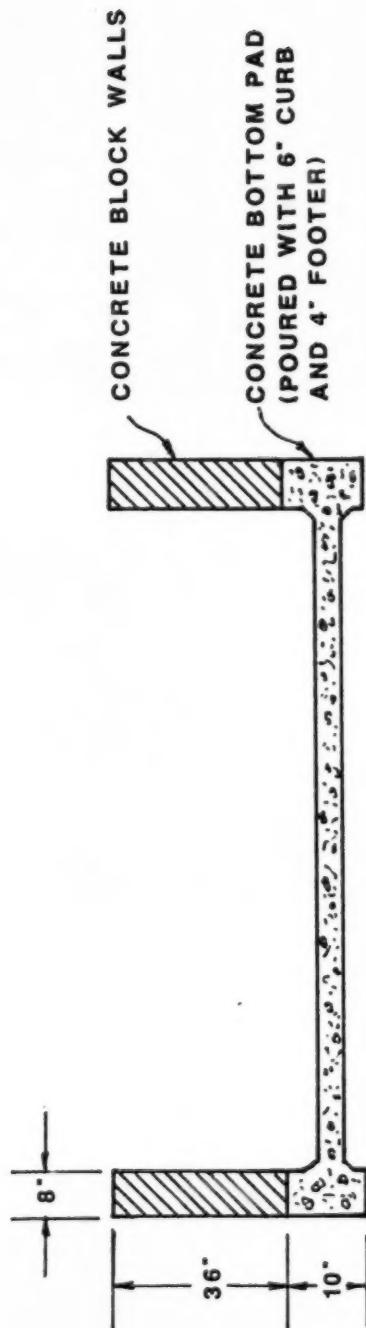
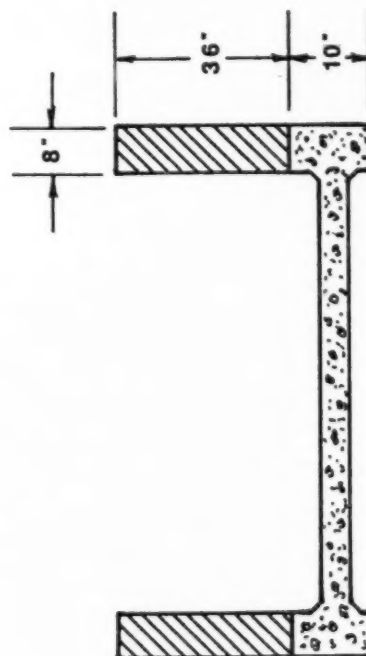


Figure 8. Selected Concrete Details



LONGITUDINAL CROSS SECTION



LATERAL CROSS SECTION

NOTES:

- EXTERIOR WALLS COATED WITH 1/2" HYDRAULIC SEALING CEMENT, THEN PARGED
- INTERIOR WALLS COATED WITH 1/2" HYDRAULIC SEALING CEMENT

Figure 9. Design Details When Concrete Block Walls Are Used

Leak Detection

In most circumstances, a properly constructed pit should not develop leaks. It can happen, however, particularly in areas that experience cold winters, and the freeze-thaw cycles might cause cracks to develop in the concrete or joints to open. In any case, leakage of the waste pesticide solutions through pit walls or bottom must be detected, should it occur.

A simple, yet effective, leak detection system can be provided by placing horizontal, perforated PVC pipes both laterally and longitudinally beneath the pit. These horizontal pipes are connected to risers placed just outside the pit walls. The tops of the risers should be about even with the top of the pit walls and should be fitted with readily removable caps to keep out precipitation.

Removal of the caps and observation of the bottom of risers will indicate whether a leak has occurred. So long as there is no leakage, the riser bottoms will be dry. When observation shows that there is liquid in the riser, a sample should be taken immediately and tested for the presence of pesticides. It is always possible that groundwater or water from some other source might leak into the area under the pit and into the detection pipes. However, properly sized and placed external liners will minimize such occurrences. The leak detection piping arrangement is depicted in Figure 10, along with liner placement.

Pit Fill

In keeping with the ISU concept, the pit should be nearly filled with three alternating layers of gravel and soil. The bottom layer should be one-inch gravel and 12 inches thick. The middle layer is to be topsoil taken from the pit site and should also be 12 inches thick. The soil should be dry and loose when placed into the pit. On top of the soil layer is another 12-inch thick layer of one-inch gravel.

The soil used in the pit should be as high in organic content as possible, to enhance the microbial activity. However, so long as the soil is reasonable good topsoil taken from the pit site or adjacent farm fields, it should be adequate.

The gravel can be commonly-occurring bank gravel or granitic gravel. If crushed stone is used for the gravel layers, limestone and sandstone should be avoided. These sorbent materials may inhibit degradation of pesticide chemicals.

The Pit Roof

The purpose of providing a roof over the pit is to prevent rain from entering the pit and overloading it. The roof can be flat or gabled, but given its function, minimizing the cost should be the guideline. If a flat roof is used, it will have to be sloped sufficiently to provide rapid run-off of rain.

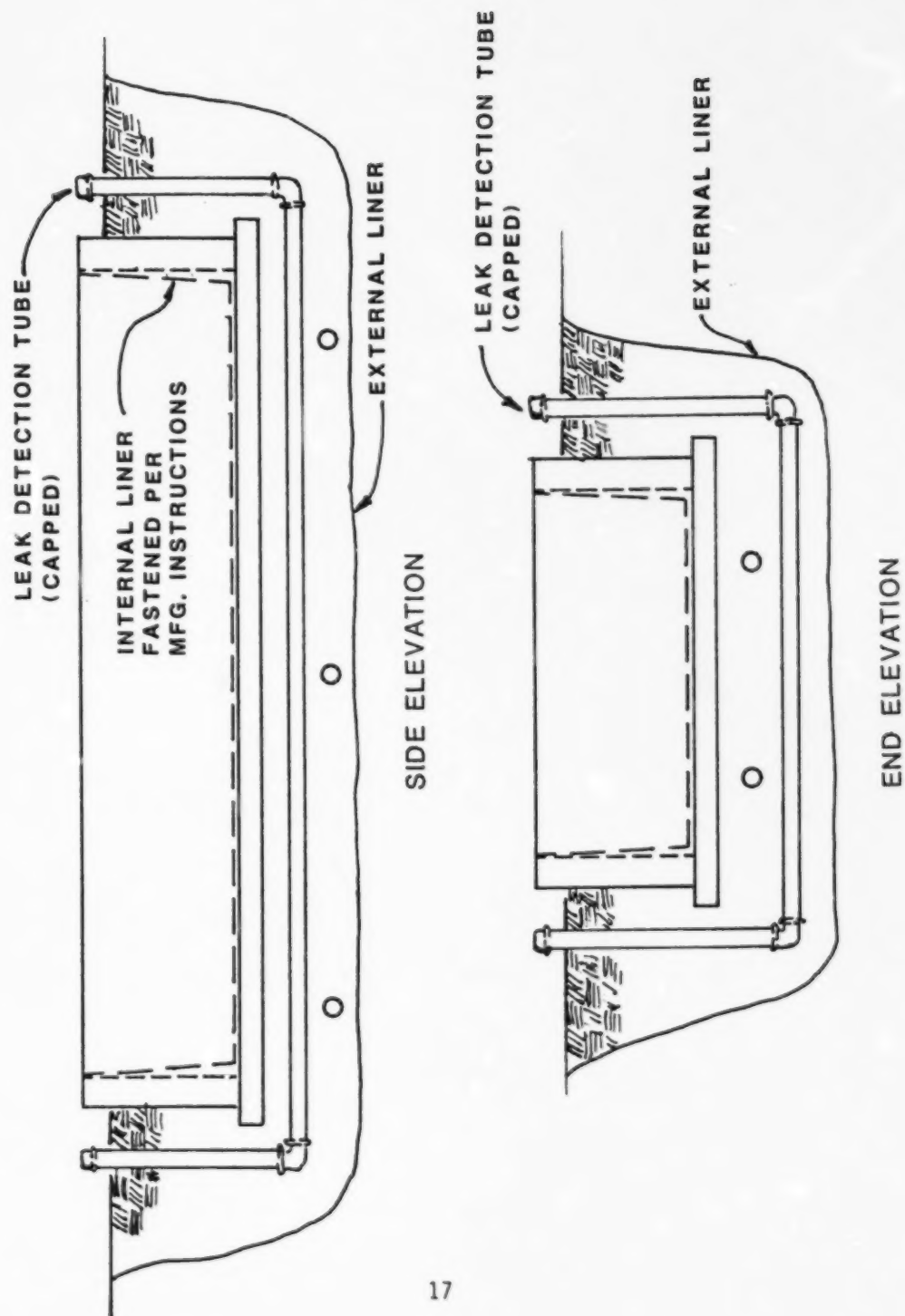
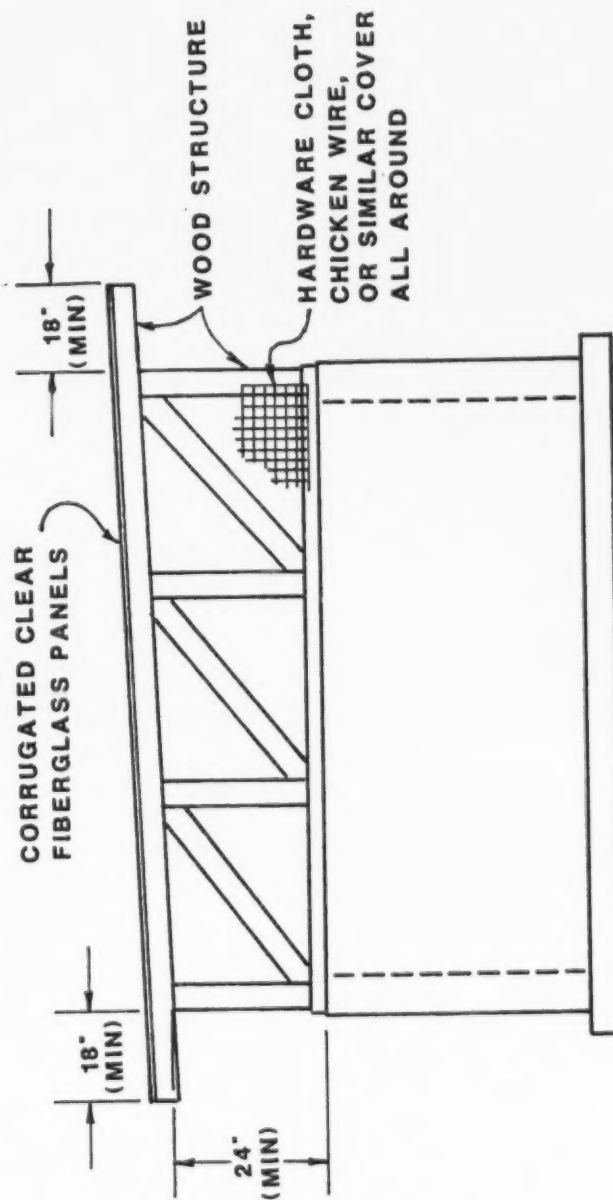


Figure 10. Pit Liners and Leak Detection

The roof should be at least 24 inches above the top of the pit walls to allow air flow over the pit surface and observation of conditions in the pit. Not only should the roof extend over the entire pit, it should overhang the pit by at least 18 inches on all four sides, to aid in keeping out blowing rain.

The roof surface should be of corrugated translucent fiberglass panels to provide durability, yet allow as much sunlight into the pit as possible. The supporting structure can be of wood or metal, whichever is most convenient. All sidewalls of the supporting structure are to be left open, except that they should be covered with hardware cloth, chicken wire, or similar material to keep out small birds and animals, livestock and people. Provision should be made for easy removal of at least one fiberglass roof panel, or a gate should be provided in one sidewall. If a gate is used, provision should be made to keep it locked. The purpose of the removable panel or gate is to allow operator access into the pit for maintenance and repair activities, as well as to take liquid and soil samples from the pit. A typical roof arrangement is shown by Figure 11.



END ELEVATION

Figure 11. Pit Roof Arrangement

SECTION 3

SITING, OPERATION AND MAINTENANCE

The location and maintenance of a pesticide pit can affect the facility's efficiency and length of useful service. If a permit is required for the pit, stringent requirements may be included for siting and operating the pit. In the absence of permit requirements, the following factors should be considered.

Locate The Pit Away From Wells

Wells are the primary source of drinking water in rural areas. They may also supply water for a variety of other uses at farms. If the pit is located close to a well, there is the possibility that leakage from the pit, should it occur, could contaminate the groundwater.

Although the use of correct construction practices in building the pit should make it leakproof, natural causes such as sudden hard freezes, normal freeze-thaw cycles, tornadoes, and earth movement may damage the pit structure and produce leaks. Therefore, the pit should be sited as far as possible from any existing wells. Thought should also be given to the likely sites of any future wells that might be drilled on the property.

Locate The Pit Away From Residences and Property Lines

Some pesticides have bad odors or are degraded into odorous compounds. Odors from a pesticide pit could cause violation of local nuisance ordinances. Complaints from neighbors could result in a legal action forcing the owner to stop using the pit and close it. From a more practical viewpoint, if a pit was placed close to a property line, a structure, hedge, or tree might later be placed on the neighbor's property that would interfere with sunlight on the pit and with air flow over the pit, thereby reducing the pit's efficiency and usefulness.

Locate The Pit Away From Surface Water Bodies

The pit should be located away from ponds, streams and lakes. The reason for this safety criteria is to assure that any accidental pesticide solution spills near the pit or leakage from the pit will not run off to nearby streams or ponds and contaminate the water. Contamination could affect the fish and wild life, and perhaps farm animals which might drink water from these bodies.

Exposure Of The Pit To Sunlight

Evaporation of water from waste pesticide solutions is critical to successful use of the pit. Therefore, it is important the pit receive as much direct sunlight as possible. This is the most important factor affecting evaporation rates. In addition, by the process of photolysis, direct sunlight can destroy some pesticides while they are still in solution. For these reasons, the pit should not be placed so close to trees, buildings, or other structures that they will interfere with sunlight striking the pit. Special consideration should be given to early morning and late afternoon hours, when shadows from nearby structures will be longest.

Unrestricted Air Flow

Air movement over the surface of the pit has less effect on evaporation than sunlight, but it can aid evaporation. Therefore, the pit site should also be a place where the free flow of air, especially the prevailing winds, is not restricted by nearby structures or trees.

Controlling Pit Liquid Level

Studies of evaporation rates have shown that maximum evaporation occurs when one inch or less of water covers the top gravel surface. As liquid depth increases, the rate of evaporation decreases quite rapidly. The evaporative capacity of the pit is seriously curtailed with more than 1-1/2 inches of liquid covering the surface. No additional waste solutions should be placed in the pit until the liquid level falls below one inch. If it appears that quantities of waste pesticide solutions that would cause pit overloading will occur frequently, consideration should be given to installing a holding tank nearby. If a holding tank were needed, the pit itself could be fitted with a liquid level sensor controlling a pump to transfer the tank contents to the pit.

Equipment Wash Racks - Controlling Washwater Quantities

In most cases, the actual amount of pesticide waste solution requiring disposal will be small. The quantities of water used to wash down containers and equipment should be held to the minimum necessary to accomplish the cleaning.

Equipment wash racks or pads are unlikely to be roofed or enclosed sufficiently to keep rain out. Therefore, to avoid draining rainwater from equipment wash racks into the pit and overloading - perhaps flooding - the pit, a diversion valve must be installed in the loading pipeline between the drains and the pit.

When the pit is not being loaded with pesticide waste solutions, the diversion valve should be positioned to divert water draining from the wash

rack into storm drains or onto the ground away from the pit. When rinsing or washing containers and equipment, the diversion valve must be positioned to direct all wastewaters into the pit. Setting the diversion valve position should be the first item and the last item on a pit operator's checklist.

Recording Pit Loadings

A continuous record should be kept of all pesticide waste solutions put into the pit. Some type of relatively permanent log book should be provided at the facility for this purpose. Each time the pit is used, an entry should be made in the log of the date, the specific chemical, the dilution rate, the approximate quantity of pesticide waste solution loaded into the pit, and the approximate quantity of washwater added.

Monitoring For Leaks

The leak detection risers should be inspected on a monthly basis to determine whether they contain any liquid. Whenever liquid appears in one of these risers, a sample should be taken immediately and tested for the presence of pesticides. At the same time, liquid samples should be taken from the bottom of the pit and tested. The results can be used for comparison purposes. In addition, further loading of the pit should be stopped, and the appropriate environmental authorities notified of the problem, so that a course of action can be established. The appropriate office to contact will be identified in the operating permit or can be found in the listing of state agencies in Appendix A.

APPENDIX A

STATE AGENCIES DEALING WITH HAZARDOUS WASTES

<u>Alabama</u>	Environmental Health Administration Solid and Hazardous Waste Division 1751 Federal Drive Montgomery, AL 36130 (205) 271-7700
<u>Alaska</u>	Department of Environmental Conservation Environmental Quality Management Section Solid Waste Management Section P.O. Box 0 Juneau, AK 99811 (907) 465-2667
<u>Arizona</u>	Department of Health Services Division of Environmental Health Services Office of Waste and Water Quality Management 2005 North Central Avenue Phoenix, AZ 85004 (602) 257-2211
<u>Arkansas</u>	Department of Pollution Control and Ecology Hazardous Waste Division P.O. Box 9583 Little Rock, AR 72219 (501) 562-7444
<u>California</u>	Waste Management Board 1020 9th Street, Suite 300 Sacramento, CA 95814 (916) 322-3330
<u>Colorado</u>	Department of Health Hazardous Materials and Waste Management Division 4210 East 11th Avenue Denver, CO 80220 (303) 331-4830

<u>Connecticut</u>	Department of Environmental Protection Division of Environmental Quality Hazardous Waste Management Unit State Office Building Hartford, CN 06106 (203) 566-4924
<u>Delaware</u>	Department of Natural Resources and Environmental Control Division of Environmental Control Solid Waste/Hazardous Waste Section 89 Kings Highway P.O. Box 1401 Dover, DE 19901 (302) 736-4781
<u>District of Columbia</u>	Department of Environmental Services Solid Waste Management Administration Hazardous Waste Division 5010 Overlook Avenue, S.W. Washington, DC 20032 (202) 767-8422/767-8414
<u>Florida</u>	Department of Environmental Regulation Division of Environmental Programs 2600 Blairstone Road Tallahassee, FL 32301 (904) 487-1855
<u>Georgia</u>	Department of Natural Resources Environmental Protection Division Land Protection Branch Hazardous Waste Management Program 205 Butler Street - Floyd Towers East - Suite 1154 Atlanta, GA 30334 (404) 656-2833
<u>Hawaii</u>	Department of Health Environmental Protection and Health Services Division Noise and Radiation Branch P.O. Box 3378 1250 Punchbowl Street Honolulu, HI 96801 (808) 548-4383
<u>Idaho</u>	Department of Health and Welfare Division of Environment Statehouse Boise, ID 83720 (208) 334-5839

<u>Illinois</u>	Environmental Protection Agency Land Pollution Control Division 2200 Churchill Road Springfield, IL 62706 (217) 782-6760
<u>Indiana</u>	Department of Environmental Management 105 South Meridian Street Indianapolis, IN 46225 (317) 232-3139
<u>Iowa</u>	Department of Natural Resources Environmental Protection Division Henry A. Wallace Building 900 East Grand Avenue Des Moines, IA 50319 (515) 281-8693
<u>Kansas</u>	Department of Health and Environment Bureau of Waste Management Building 321 - Forbes Field Topeka, KS 66620 (913) 862-9360
<u>Kentucky</u>	Department for Environmental Protection Division of Waste Management Fort Boone Plaza 18 Reilly Road Frankfort, KY 40601 (502) 564-6761
<u>Louisiana</u>	Department of Environmental Quality Solid Waste/Hazardous Waste Division P.O. Box 44066 Baton Rouge, LA 70804 (504) 342-1216/342-1227
<u>Maine</u>	Department of Environmental Protection Bureau of Oil and Hazardous Materials Control State House, Station 17 Augusta, ME 04333 (207) 289-2651
<u>Maryland</u>	Department of Health and Mental Hygiene Waste Management Administration 201 West Preston Street Baltimore, MD 21201 (301) 225-5647

<u>Massachusetts</u>	Executive Office of Environmental Affairs Department of Environmental Quality Engineering Solid and Hazardous Waste Division One Winter Street Boston, MA 02108 (617) 292-5851
<u>Michigan</u>	Department of Natural Resources Hazardous Waste Division P.O. Box 30028 Lansing, MI 48909 (517) 373-2730
<u>Minnesota</u>	Pollution Control Agency Solid and Hazardous Waste Division 520 Lafayette Road St. Paul, MN 55155 (612) 296-7282
<u>Mississippi</u>	Department of Natural Resources Bureau of Pollution Control P.O. Box 10385 Jackson, MS 39209 (601) 961-5100
<u>Missouri</u>	Department of Natural Resources Division of Environmental Quality Waste Management Program P.O. Box 176 205 Jefferson Street Jefferson City, MO 65102 (314) 751-3176
<u>Montana</u>	Department of Health and Environmental Sciences Environmental Sciences Division Solid and Hazardous Waste Management Bureau Cogswell Building Helena, MT 59620 (406) 444-2821
<u>Nebraska</u>	Department of Environmental Control Land Quality Division/Hazardous Waste Section State Office Building, 301 Centennial Mall South Lincoln, NE 68509 (402) 471-2186
<u>Nevada</u>	Department of Conservation and Natural Resources Division of Environmental Protection Hazardous Waste Section 221 South Fall Street, Capitol Complex Carson City, NV (702) 885-4670

<u>New Hampshire</u>	Department of Environmental Services Division of Waste Management 6 Hazen Drive Concord, NH 03301-6527 (603) 271-4608
<u>New Jersey</u>	Department of Environmental Protection Hazardous Waste Management/Hazardous Site Mitigation 401 East State Street Trenton, NJ 08625 (609) 292-1252/984-2902
<u>New Mexico</u>	Health and Environmental Department Environmental Improvement Division P.O. Box 968 Santa Fe, NM 87504-0968 (505) 827-0020
<u>New York</u>	Department of Environmental Conservation Division of Solid and Hazardous Waste 50 Wolf Road Albany, NY 12233 (518) 457-6603
<u>North Carolina</u>	Department of Human Resources Division of Health Services Solid and Hazardous Waste Management Branch P.O. Box 2091 306 North Wilmington Street - 213 Bath Building Raleigh, NC 27602-2091 (919) 733-2178
<u>North Dakota</u>	Health Department Hazardous Waste Management and Special Studies 1200 Missouri Avenue Box 5520 Bismark, ND 58502-5520 (701) 224-2366
<u>Ohio</u>	Environmental Protection Agency Division of Solid and Hazardous Waste Management P.O. Box 1049 361 East Broad Street Columbus, OH 43266-1049 (614) 466-7220
<u>Oklahoma</u>	State Health Department Environmental Health Services Industrial and Solid Waste Division 1000 NE 10th Street P.O. Box 53551 Oklahoma City, OK 73152 (405) 271-5338

<u>Oregon</u>	Department of Environmental Quality Solid Waste Division 811 SW 6th Avenue Portland, OR 97204 (503) 229-5913
<u>Pennsylvania</u>	Department of Environmental Resources Bureau of Waste Management Fulton Building P.O. Box 2063 Harrisburg, PA 17120 (717) 787-6239
<u>Rhode Island</u>	Department of Environmental Management Division of Solid and Hazardous Waste 75 Davis Street Providence, RI 02903 (401) 277-2306
<u>South Carolina</u>	Board of Health and Environmental Control Bureau of Solid and Hazardous Waste 2600 Bull Street Columbia, SC 29201 (803) 734-5200
<u>South Dakota</u>	Department of Water and Natural Resources Office of Air Quality and Solid Waste Joe Foss Building Pierre, SD 57501 (605) 773-3153
<u>Tennessee</u>	Department of Health and Environment Division of Solid Waste Management Customs House, 701 Broadway Nashville, TN 37219 (615) 741-3424
<u>Texas</u>	Water Commission Hazardous and Solid Waste Enforcement Division P.O. Box 13087 Capitol Station Austin, TX 78711 (512) 463-8425/463-7760
<u>Utah</u>	Department of Health Division of Environmental Health Bureau of Solid and Hazardous Waste Management 1460 West 288 North P.O. Box 16690 Salt Lake City, UT 84116-0690 (801) 538-6170

<u>Vermont</u>	Agency of Environmental Conservation Department of Water Resources Environmental Engineering 103 South Main Street/West Building Waterbury, VT 05676 (802) 244-8702
<u>Virginia</u>	Department of Waste Management Bureau of Hazardous Waste 101 North 14th Street Richmond, VA 23219 (804) 225-2667
<u>Washington</u>	Department of Ecology Solid and Hazardous Waste Programs Hazardous Waste Section Mail Stop PV-11 Olympia, WA 98504-8711 (206) 459-6690
<u>West Virginia</u>	Department of Health Office of Environmental Health 1800 Washington Street East Charleston, WV 26505 (304) 348-2970
<u>Wisconsin</u>	Department of Natural Resources Bureau of Solid Waste Management 101 South Webster Street Madison, WI 53707 (608) 266-2111
<u>Wyoming</u>	Environmental Quality Solid Waste Management Program 122 West 25th Street Cheyenne, WY 82002 (307) 777-7752

APPENDIX B

U.S. EPA REGIONAL OFFICES
RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) CONTACTS

Region I	State Waste Programs Branch Waste Management Division John F. Kennedy Federal Building Boston, MA 02203 (617) 223-6883
Region II	Air and Waste Management Division 26 Federal Plaza New York, NY 10007 (212) 264-2301
Region III	Hazardous Waste Management Division 841 Chesnut Street Philadelphia, PA 19107 (215) 597-8131
Region IV	Waste Management Division 345 Courtland Street, N.E. Atlanta, GA 30365 (404) 347-3454
Region V	Waste Management Division Solid Waste Branch Federal Building, 230 South Dearborn Mail Code 5HS Chicago, IL 60604 (312) 353-4783
Region VI	Hazardous Waste Management Division First International Building, 1201 Elm Street Dallas, TX 73270 (214) 767-2730
Region VII	RCRA Branch Waste Management Division 726 Minnesota Avenue Kansas City, KS 66101 (913) 236-2930

Region VIII	Waste Management Division 1 Denver Place, Suite 600 999 18th Street Denver, CO 80202-2413 (303) 293-1720
Region IX	Toxics and Waste Management Division 215 Freemont Street San Francisco, CA 94105 (415) 974-7460
Region X	Hazardous Waste Division 1200 6th Avenue Seattle, WA 98101 (206) 442-1090

APPENDIX C

SOURCE OF CLIMATIC INFORMATION

National Climatic Data Center
Federal Building
Asheville, NC 28801-2696
(704) 259-0682